

We claim:

1. A transition metal compound of the formula (I)

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where

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(l)

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and

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is a divalent group such as

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and

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M<sup>1</sup> is titanium, zirconium or hafnium;

R<sup>1</sup>,R<sup>2</sup> are identical or different and are each a C<sub>1</sub>-C<sub>20</sub> group;

R<sup>1</sup>',R<sup>2</sup>' are identical or different, identical to or different from R<sup>1</sup> or R<sup>2</sup> and are each hydrogen or a C<sub>1</sub>-C<sub>20</sub> group;

R<sup>3</sup>

is a C<sub>6</sub>-C<sub>18</sub>-aryl group or C<sub>4</sub>-C<sub>18</sub>-heteroaryl; or a fluorinated C<sub>6</sub>-C<sub>20</sub>-aryl or C<sub>7</sub>-C<sub>20</sub>-alkylaryl, where the aryl part of these groups may bear one or more linear or branched C<sub>1</sub>-C<sub>18</sub>-alkyl, C<sub>1</sub>-C<sub>18</sub>-alkoxy, C<sub>2</sub>-C<sub>10</sub>-alkenyl or C<sub>3</sub>-C<sub>15</sub>-alkylalkenyl groups as substituents, or R<sup>3</sup> together with R<sup>4</sup> forms a monocyclic or polycyclic ring system which may in turn be substituted:

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R<sup>3'</sup> is hydrogen or a C<sub>1</sub>-C<sub>40</sub> group or R<sup>3'</sup> together with R<sup>4'</sup> forms a monocyclic or polycyclic ring system which may in turn be substituted;

R<sup>4</sup>,R<sup>4</sup> are identical or different and are each hydrogen or a C<sub>1</sub>-C<sub>20</sub> group;

R<sup>5</sup>,R<sup>5</sup>,R<sup>6</sup>,R<sup>6</sup> are identical or different and are each hydrogen or a C₁-C₂₀ group;

is a bridging structural element between the two indenyl radicals and is selected from the M<sup>2</sup>R<sup>10</sup>R<sup>11</sup> group, where M<sup>2</sup> is silicon, germanium, tin or carbon and R<sup>10</sup> and R<sup>11</sup> may be identical or different and are each hydrogen or a C<sub>1</sub>-C<sub>20</sub>-hydrocarbon-containing group;

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<sup>8</sup>,R<sup>9</sup> may be identical or different and are each halogen, linear or branched C<sub>1</sub>-C<sub>20</sub>-alkyl, substituted or unsubstituted phenoxide, or R<sup>8</sup> and R<sup>9</sup> are joined to one another and form a monocyclic or polycyclic ring system which may in turn be substituted.

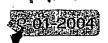
2. A transition metal compound as claimed in claim 1, wherein

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where the substituents R<sup>3</sup> to R<sup>6</sup> and R<sup>3</sup> to R<sup>6</sup> are defined as for formula (I).

- 3. A transition metal compound as claimed in claim 1 or 2, wherein
  - M<sup>1</sup> is zirconium;
  - R<sup>1</sup>.R<sup>2</sup> are identical or different and are each a C<sub>1</sub>-C<sub>12</sub>-alkyl group;
- 30 R<sup>1</sup>,R<sup>2</sup> are identical or different and are each hydrogen, methyl, ethyl, n-propyl, isopropyl
  - n-butyl, isobutyl, tert-butyl, cyclopentyl or cyclohexyl;
  - R<sup>3</sup>,R<sup>3'</sup> are identical or different and are each a C<sub>6</sub>-C<sub>18</sub>-aryl group or two radicals R<sup>3</sup> together with R<sup>4'</sup> may form a monocyclic or polycyclic ring system which may in turn be substituted, and R<sup>3'</sup> may also be hydrogen;
  - R<sup>4</sup>,R<sup>4'</sup> are identical or different and are either hydrogen or R<sup>4</sup> together with R<sup>3</sup> and/or R<sup>4'</sup> together with R<sup>3'</sup> form a monocyclic or polycyclic ring system;
  - R<sup>5</sup>,R<sup>6</sup>,R<sup>6</sup> are identical or different and are each hydrogen, linear or branched C<sub>1</sub>-C<sub>18</sub>-alkyl, C<sub>2</sub>-C<sub>10</sub>-alkenyl or C<sub>3</sub>-C<sub>15</sub>-alkylalkenyl, C<sub>6</sub>-C<sub>20</sub>-aryl, C<sub>4</sub>-C<sub>18</sub>-heteroaryl, C<sub>7</sub>-C<sub>20</sub>-arylalkyl; or fluorinated C<sub>1</sub>-C<sub>12</sub>-alkyl, C<sub>2</sub>-C<sub>10</sub>-alkenyl, C<sub>6</sub>-C<sub>20</sub>-aryl or C<sub>7</sub>-C<sub>20</sub>-arylalkyl;

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R<sup>7</sup> is a bridging structural element SiR<sup>10</sup>R<sup>11</sup> and R<sup>10</sup> and R<sup>11</sup> are identical or different and are each a C<sub>1</sub>-C<sub>20</sub>-hydrocarbon-containing group and R<sup>8</sup>,R<sup>9</sup> are each chlorine or methyl.

5 4. A ligand system of the formula (II) or its double bond isomers,

where the variables are as defined for formula (I).

5. A process for preparing ansa-metallocenes of the formula (I), which comprises the following steps:

a) reaction of a 1-indanone of the formula (III) or (III') with an organometallic compound M<sup>3</sup>R<sup>2</sup><sub>m</sub>Hal<sub>n</sub> or M<sup>3</sup>R<sup>2'</sup><sub>m</sub>Hal<sub>n</sub> and subsequent elimination to form the substituted indene of the formula (IV) or (IV'),

$$R^1$$
 $R^3$ 
 $R^4$ 
 $R^5$ 
 $R^5$ 

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where the variables R<sup>1</sup>, R<sup>1</sup>, R<sup>2</sup>, R<sup>2</sup>, R<sup>3</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>5</sup>, R<sup>6</sup> and R<sup>6</sup> are as defined for formula (I), M<sup>3</sup> is an alkali metal, an alkaline earth metal, aluminum or titanium, Hal is halogen, m is an integer and is equal to or greater than 1 and the sum of m+n corresponds to the valence of M<sup>3</sup>;

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b) deprotonation of the substituted indene of the formula (IV) or (IV') and subsequent reaction of the deprotonated indene with compounds of the type R<sup>7</sup>X<sub>2</sub> to form compounds of the formula (V) or (V') or their double bond isomers.

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c) reaction of the compound of the formula (V) or (V') with a further deprotonated indene which has been obtained by deprotonation of (IV) or (IV') to form the ligand system of the formula (IIa) or its double bond isomers,

where X is CI, Br, I or O-tosyl and R7 is as defined for formula (I):

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$$R^{5}$$
 $R^{6}$ 
 $R^{7}$ 
 $R^{6}$ 
 $R^{7}$ 
 $R^{6}$ 
 $R^{7}$ 
 $R^{6}$ 
 $R^{7}$ 
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 $R^{7}$ 
 $R^{7}$ 
 $R^{7}$ 

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deprotonation of the ligand system of the formula (IIa) or its double bond isomers and reaction with compounds of the type  $X_2M^1R^8R^9$  to give the ansa-metallocene of the formula (I), where X is as defined for formula (V) and  $M^1$ ,  $R^8$  and  $R^9$  are as defined for formula (I).



6. An indene of the formula (IV) or its double bond isomer,

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where

R<sup>1</sup>,R<sup>2</sup> are identical or different and are each a C<sub>1</sub>-C<sub>20</sub> group;

R<sup>3</sup> is a C<sub>6</sub>-C<sub>18</sub>-aryl group or C<sub>4</sub>-C<sub>18</sub>-heteroaryl; or a fluorinated C<sub>6</sub>-C<sub>20</sub>-aryl or C<sub>7</sub>-C<sub>20</sub>-alkylaryl, where the aryl part of these groups may bear one or more linear or branched C<sub>1</sub>-C<sub>18</sub>-alkyl, C<sub>1</sub>-C<sub>18</sub>-alkoxy, C<sub>2</sub>-C<sub>10</sub>-alkenyl or C<sub>3</sub>-C<sub>15</sub>-alkylalkenyl groups as substituents;

R<sup>4</sup> is hydrogen or a C<sub>1</sub>-C<sub>20</sub> group;

R<sup>5</sup>, R<sup>6</sup> are identical or different and are each hydrogen or a C<sub>1</sub>-C<sub>20</sub> group.

- A catalyst system comprising one or more compounds of the formula (I) as claimed in any
  of claims 1 to 3 and one or more cocatalysts and/or supports.
  - 8. The use of a catalyst system as claimed in claim 7 for the preparation of a polyolefin, in particular a copolymer of various olefins.

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- 9. The use of a compound of the formula (I) as claimed in any of claims 1 to 3 for the preparation of a polyolefin, in particular a copolymer of various olefins.
- 10. The use as claimed in claim 8 or 9 for the preparation of ethylene-propylene copolymers.

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11. A process for preparing a polyolefin by polymerization of one or more olefins in the presence of one or more compounds of the formula (I) as claimed in any of claims 1 to 3.

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